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The Petroleum Situation

CHASE

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MESSAGE FROM CHASE ENERGY ECONOMICS

Please note that if you wish to continue to receive this publication, you must complete and return the questionnaire contained on pages 7 and 8. Due to the unprecedented response to our previous issue covering the U.S. natural gas industry, we will return to this subject in our next issue. We welcome any comments you might have on the subject of the natural gas industry or the worldwide refining industry, the subject of this issue.

David J. Behling, Jr.

THE CHANGING STRUCTURE OF THE WORLD REFINING INDUSTRY

Over the past ten years, worldwide petroleum refining capacity has expanded much faster than world consumption of petroleum products. A consequence has been declining refining profitability. In this article, we review the various factors which have led to the current overcapacity and present our outlook for the industry for the next few years. Our conclusion is that, over the balance of 1984 and 1985, worldwide profitability will improve slowly, as increases in demand are partially offset by the start-up of several large, state-owned refineries. During this transition period, more rationalization of existing capacity can be expected, particularly in Western Europe and Singapore. However, the financial position of those refineries that make it through this period should then improve substantially over the balance of the decade.

Refining Technology

To understand why the refining industry has had a difficult time adjusting to its radically changed post-1973 environment, a brief description of the technology of petroleum refining is needed. A petroleum refinery first separates crude oil into different boiling range fractions, or cuts, in a process called crude distillation. These fractions are then processed into marketable petroleum products. Since crude oils vary considerably in their composition, the yield of the fractions obtained through crude distillation also varies. Table 1 shows the various product yields obtained by the distillation of three important crude oils of differing qualities.

TABLE 1

APPROXIMATE YIELD OF FRACTIONS OBTAINED FROM CRUDE DISTILLATION OF THREE IMPORTANT CRUDE OILS

Type of Fraction	Boiling Range (Degrees Farenheit)	Product Yields from: Arab Light (%)	Brent North Sea (%)	West Texas Intermediate (%)
Butane & Lighter	Less than 65°	1.9	3.6	2.0
Naphtha	65°-320°	17.4	24.5	31.6
Kerosene	320°-450°	16.5	12.6	9.4
Middle Distillate	450°-650°	19.7	20.7	16.9
Vacuum Gas Oil	650°-1050°	29.8	28.3	25.1
Vacuum Residue	1050° Plus	14.8	10.3	15.0
Total		100.1	100.5	100.0

SOURCES: Arab Light — *Oil and Gas Journal*, "Guide to Export Crudes for the '80's"; April 11, 1983, p. 73.
Brent — Ibid; May 23, 1983, p. 73.
West Texas Intermediate — company data.

Only some of the cuts derived from the distillation of crude oil are of immediate use, needing no further processing. Some middle distillate can be used directly as diesel fuel; some kerosene for light fuel. Most of the fraction streams, however, require further modification. The conversion processes used are many, and some are very complex, but they can be separated into the following four general groups (in addition to crude distillation):

- Clean-up processes
- Property enhancement processes
- Polymerization/condensation processes
- Cracking processes

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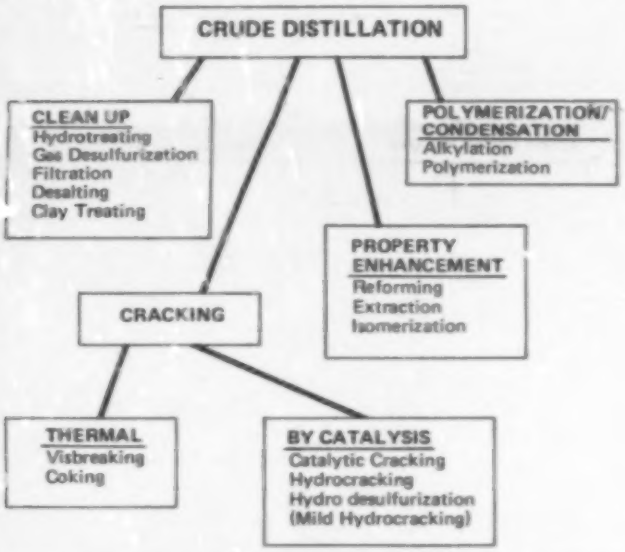
Figure 1 lists some of the major refinery operations under these headings. Those operations listed under clean-up remove unwanted material from petroleum streams. They include the removal of sulfur or nitrogen that may be chemically combined with oil and the removal of water or suspended solids. The property enhancement processes often involve chemical change but, in general, they retain such essential physical properties as the boiling range of the stream. For example, through the reforming process, octane of the naphtha fraction is increased by changing the chemical structure.

FIGURE 1

IMPORTANT REFINING PROCESSES



Polymerization/condensation processes take light fractions and chemically convert them into heavier products, generally for blending into gasoline. Cracking processes, alternatively, take those heavy fractions boiling above 650°F and convert them, or "crack" them, into lighter products. Cracking can occur by using heat alone (thermal cracking); it can involve a catalyst (catalytic cracking); and it can be carried out in the presence of hydrogen (hydrocracking). The desulfurization of oil, particularly heavy oil, also entails some hydrocracking.

Over the past decade, more and more conversion process capacity has been used to achieve increases in the yield of premium products obtained from a barrel of any given type of crude oil. Premium oil products are generally those which have few close substitutes. They include transportation fuels (motor gasoline, diesel fuel, and jet fuel), petrochemical feedstocks (naphtha and olefins), and specialist fuels with special burning characteristics (kerosene for home cooking units). Premium products are usually obtained by blending together the lighter fractions which boil at 650°F or less.

Demand for Refined Products

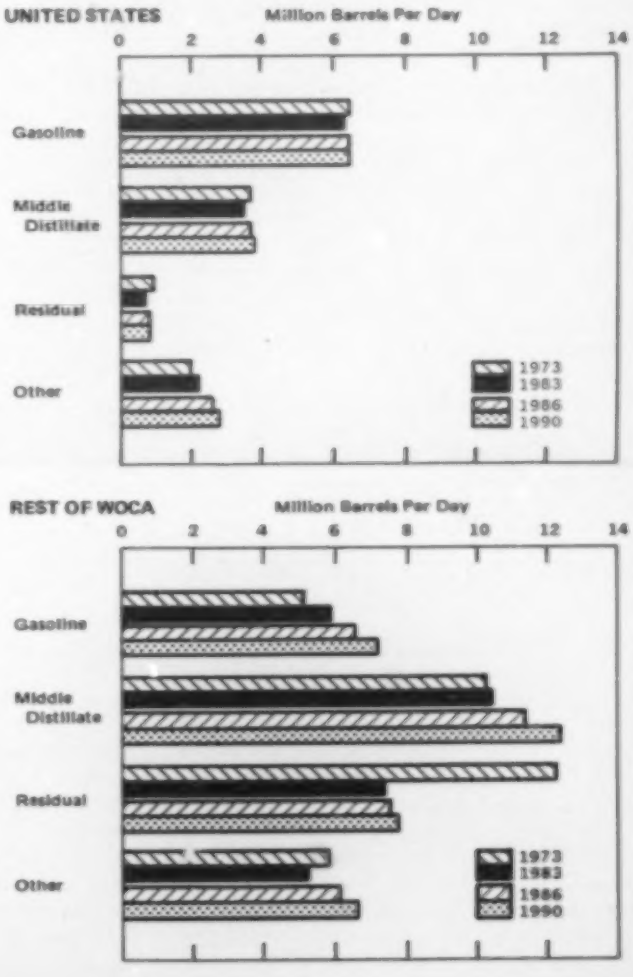
Figure 2 shows the production of each of the major types of output in both the U.S. and the rest of the World Outside the Communist Areas (WOCA) in 1973 and 1983, with our best estimate forecasts for 1986 and 1990. In the U.S., there was little change over the 1973 to 1983 period in the level of production of any type of product. The most noticeable change over the forecast period is the growth in production of "other" products, mainly petrochemical feedstocks. For the rest of WOCA, between 1973 and 1983, a far greater change took place than in the U.S. There was a marked increase in the production of lighter products (gasoline and middle distillates), a sharp decrease in the production of residual fuel oil and a smaller decrease in the production of other outputs.

Over the forecast period, in the rest of WOCA, we expect continued production increases for gasoline and, particularly, for middle distillates. However, we also expect the production of residual fuel oil and other products to increase, breaking the trend established during the 1973-1983 period.

In general, considering both the U.S. and the rest of WOCA, residual fuel oil production has shown the great-

FIGURE 2

REFINERY OUTPUT BY REGION AND TYPE OF PRODUCT



est change. While, since 1973, sharply rising oil product prices have resulted in reduced consumption of most all oil products, the demand for residual fuel oil has been affected the most. The reason is that increases in residual fuel oil prices have eliminated, in most areas, any price advantage that residual fuel oil once possessed over alternative fuels used in the generation of electricity and in large industrial boilers. While residual fuel oil consumption has fallen precipitously, both in the U.S. and elsewhere, practically all of the corresponding decline in residual fuel production has been borne by refineries located outside the U.S. This is because historically most residual fuel oil was produced overseas, with large amounts exported to the U.S. Since 1973, U.S. imports of residual fuel oil have declined by almost two-thirds.

Over the forecast period, we expect that this trend of substituting alternative fuels for residual fuel oil will not continue as strongly as in the past, since in most areas the price of residual fuel oil is not expected to increase, compared with that of other fuels. However, we still expect the share of residual fuel oil in total WOCA oil production to further decline to 23 percent in 1987, from 26 percent in 1983 and 37 percent in 1973.

Refining Capacity

Figure 3 shows WOCA refining capacity for crude distillation and for five different conversion processes over the period since 1980, along with forecasts for the period to 1987. The forecasts are based on announced capacity expansions (with some modification for delays and cancellation) and our own estimates of capacity retirements. Since 1980, considerable crude distillation capacity has been retired, particularly in Europe and, to a lesser extent, in the U.S. Over the forecast period, we expect this trend to continue, but at a lesser rate now that world oil demand and production have begun to increase again. In the developing countries, however, we expect that crude distillation capacity will increase, primarily because of large capacity expansions scheduled in several OPEC countries.

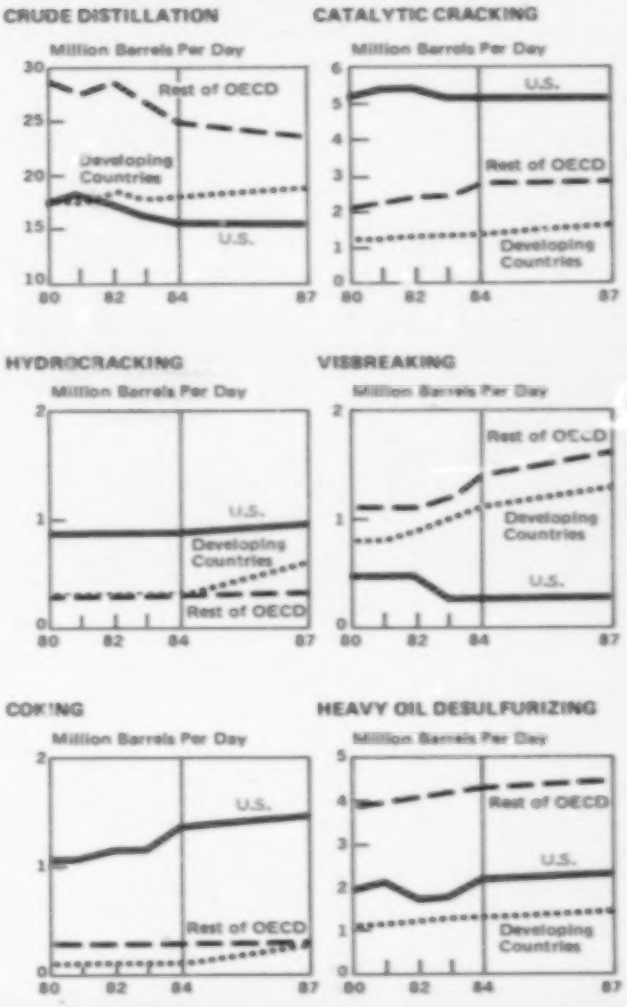
The trends are quite different for the five conversion processes shown in Figure 3. Capacity has been increasing for all types shown except hydrocracking, in most cases substantially, even as demand for oil products has declined. Much of the new conversion capacity was added in the late 1970s and in 1980, when WOCA oil product demand levels were expected to reach more than 50 million barrels daily by the mid-1980s.

In fact, in 1983 WOCA oil product consumption turned out to be 44.5 million barrels daily. However, demand for conversion capacity has not declined as much as demand for all petroleum products. The shift towards greater conversion of vacuum gas oil and vacuum residue into lighter fractions has supported greater utilization of conversion processes than of the crude oil distillation capacity. The late 1970s forecasting consensus that products, on average, would become lighter has been verified.

Over the forecast period, conversion capacity is expected to continue to increase, albeit much more gradually, with the greatest expansions being those for visbreaking, coking (thermal cracking) and heavy oil desulfurizing. In the U.S., little net increase is expected in any type of cracking capacity. Still, the U.S. will continue to

FIGURE 3

WOCA REFINING CAPACITY BY REGION AND TYPE (MILLION BARRELS PER DAY OF THROUGHPUT AS OF JANUARY 1)



have the greatest availability of all types of cracking capacity except visbreaking. Outside the U.S., net additions are expected for most types of conversion capacity. Over the 1984 to 1986 period, three new refineries are coming on stream in Saudi Arabia (Janbu, Al Jubail and Rabigh) and one in Libya (Ras Lanaf). Together, these will add 2.5 percent to the current amount of WOCA crude oil distillation capacity outside the U.S. and 6.5 percent to the amount of cracking conversion capacity.

Trends in Refinery Ownership

Not only has there been a significant change in the relative importance of the different processes, with many conversion processes becoming much more important, but also there has been a change in the ownership status of refineries. Shares of the majors, independents and state-owned companies in the ownership of crude distillation capacity in the U.S. and the rest of WOCA are

shown in Figure 4. In the U.S., the major change since 1973 has been the increase in the share of capacity held by independent refiners.

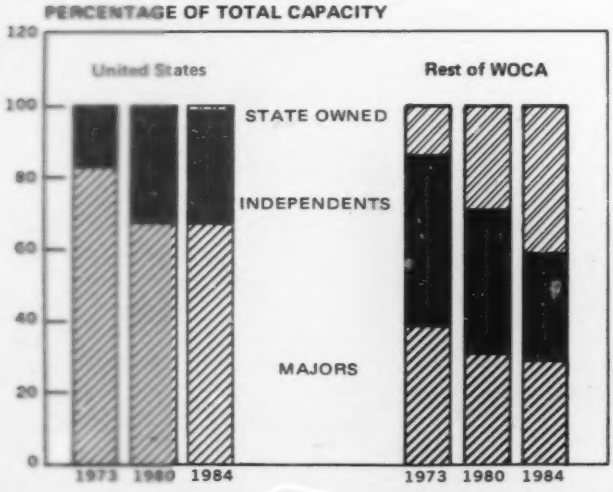
This increase was due to the "small refiner bias" present during the 1973-1979 period. Under the Federal price control legislation then in place, small refiners received subsidies from large refiners. Since the removal of this small-refiner bias in the 1980 crude oil decontrol, both independents and majors have reduced capacity. Up to the beginning of 1984, however, the declines have been roughly in step, so that the share of capacity owned by independents has held approximately at the 1980 level through the beginning of 1984.

The recent Mobil-Superior, Chevron-Gulf and Texaco-Getty mergers are now leading to some additional reduction in refining capacity held by the majors, since some refining capacity obtained in the mergers is either being retired or sold to independents. However, on balance, we expect that it will be primarily the capacity now owned by the smaller independent refineries that will be closed over the next few years, barring more large mergers between the majors. Thus, we expect that the share of capacity owned by the majors will rise in the U.S. over the forecast period. Although some increase in the ownership of refineries by state-owned companies can also be expected in the U.S., the state-owned share should remain negligible.

The picture is more complex outside the U.S., as both independents and majors face significant competition from state-owned refineries. The share of total refining capacity which is state-owned has increased from 15 percent in 1973 to 29 percent in 1980 and 42 percent in 1984. This expansion has come primarily at the expense of the independents. It is the result of a desire by many OPEC countries to refine more of their own crude oil, thereby capturing more of the "value added." Also, governments in several non-oil-exporting developing countries have become more active in refining. In the next few years, outside the U.S., the share of government-owned capacity in total capacity will continue to increase, as the new large OPEC refineries come on stream. Moreover, the trend toward government purchases of privately-owned refinery assets will continue in many non-oil-exporting developing countries.

FIGURE 4

SHARES OF CRUDE DISTILLATION CAPACITY BY SEGMENT



Capacity Utilization

While refining capacity utilization is below historic levels everywhere, the recent trends in utilization differ markedly across regions. Figure 5 shows the utilization of crude distillation capacity and cracking capacity in the U.S. and in the rest of WOCA. In the U.S., demand for oil price controls through 1979, so that crude distillation capacity utilization was far greater in the U.S. than in the world outside of CPE's during this period. Once U.S. crude oil price controls were removed, in 1980, and free trade in crude oil and products reestablished, the average utilization rate of U.S. distillation capacities dropped quickly to that of capacity located in the world outside of CPE's. In 1983, average crude distillation capacity utilization improved both in the U.S. and elsewhere, due to closing of excess capacity. In 1984, we expect further increases in U.S. capacity utilization due primarily to increased U.S. production of petroleum products. In the rest of the world, average capacity utilization should also improve, primarily because of the closing of more capacity. Beyond 1984, we expect rising product demand to be the main factor behind improving capacity utilization rates in both regions.

As shown in Figure 5, capacity utilization of cracking capacity in both the U.S. and the rest of WOCA declined through 1982 and then improved in 1983. The decline was particularly severe outside the U.S. because of the sharper fall-off in the demand for lighter products taking place there. In 1983, conversion capacity utilization improved slightly in both areas, due primarily to a net removal of capacity, but also, in part, to a change in product-mix composition toward greater amounts of lighter products.

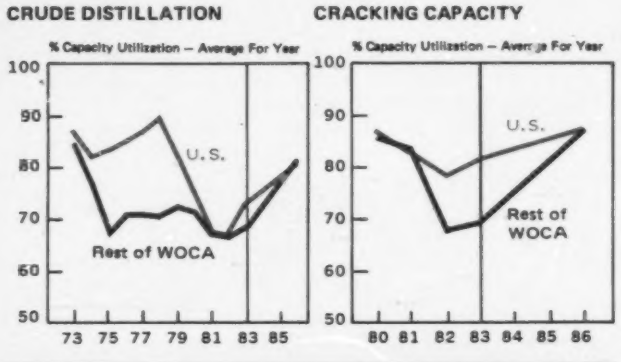
We foresee that a more rapid overseas expansion in the production of lighter products will lead to a faster recovery of capacity utilization outside the U.S. This expansion will now more than offset the amounts of new OPEC capacity coming on stream. Increasingly more light products produced in Europe and Latin America will be exported to the U.S., where U.S. imports of petroleum products, excluding residual fuel oil, are expected to increase from 0.9 million barrels daily in 1983 to 1.6 million barrels daily in 1986. In just the first six months of 1984, versus a year ago, U.S. product imports, excluding residual fuel oil, increased by 0.4 million barrels per day. Much of this, of course, was due to a weather-induced U.S. shortage of heating oil in the early months of this year. However, higher product imports have been persisting throughout the summer and early fall and we expect this trend to continue.

Refining Profitability

With the rising utilization of both distillation and cracking capacities, worldwide refining profitability should also improve. Refining cash operating profits equal the revenue generated by selling petroleum products less the acquisition costs of crude oil and other feedstocks

FIGURE 5

CAPACITY UTILIZATION



and the cost of refining those feedstocks. Estimates of the average product revenues received per barrel of feedstock charged are shown in Figure 6 for the U.S., Europe and Singapore, which is the major offshore refining center for the Far East. Singapore accounts for 12 percent of 1983 production in the Far East, Japan 46 percent and the remainder 42 percent.

For the period between 1973 and 1980, U.S. revenue received per barrel of feedstock was less than that for Europe, despite the fact that U.S. refineries produced a higher proportion of premium products. The lower U.S. product realization reflected the impact of U.S. federal crude oil price controls in dampening product prices. After 1979, with the removal of price controls, the U.S. unit revenues increased to the level of revenues elsewhere. Since 1981, per-barrel revenues have been declining everywhere in line with declining crude oil prices.

To determine the cash operating profits shown in Figure 7, for the three different regions, variable and fixed costs per barrel of feedstock were estimated for each region, including the interest costs on working capital. Depreciation and the interest on long-term debt were not included, however, since these fixed charges tend to vary greatly with the size of the company, the age of the plant and regional accounting practices. All costs (excluding depreciation and interest on long-term debt) were then subtracted from the average revenues shown in Figure 6 to obtain the cash operating profits shown in Figure 7.

In analyzing these financial relationships, several trends stand out. First, in 1979 and 1980, and, to a lesser extent, in 1973 in Europe, profits were abnormally high. In each case, operating profits obtained from operations were considerably boosted by inventory profits, which, in turn, were the result of the two OPEC oil price stocks. After reaching peak levels everywhere in 1979 and 1980, unit cash operating profits declined sharply outside the U.S., reaching a loss of about $2 per barrel in Europe in 1982 and $1.50 a barrel in Singapore in 1981.

By 1983, regional profit differentials were much reduced, with cash operating profits for Singapore and Europe increasing, and with Singapore operating profits reaching that of the average U.S. refinery. The Far East as a whole, became considerably more profitable than the U.S., as Japanese profits in 1983 were also much improved over 1982. European profits were lowest, in line with the greater degree of excess capacity in Europe. With cash operating profits from refining still low for all of 1983, however, little cash was available for either replacing capital equipment or for covering interest charges on outstanding debt, let alone for paying dividends to stockholders. Of course, majors and state-owned companies usually had access to other sources of cash inflow, a luxury not available to independent refiners.

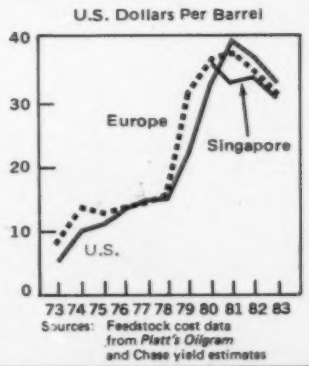
In the first quarter of 1984, profitability increased sharply almost everywhere, but it has subsequently fallen back just as rapidly. For the year as a whole, we expect a decrease in average worldwide profitability despite rising capacity utilization. For 1984, as in 1983, some decline in the average price of all products will lead to net inventory losses. In addition, prices for normally high-priced motor gasoline were severely depressed over the middle of the year, due to excess motor gasoline inventory levels. For the balance of 1984 and 1985 at least, we do not expect that average cash operating profitability for refineries owned by the majors will rise much above that level needed to cover replacement costs and interest charges on outstanding debt. Since independent refiners, taken as a group, have a higher debt/equity ratio than the majors, they will tend to remain more financially depressed during the next year and a half.

The good news is that we expect profitability to begin to improve and that this improvement should continue as long as capacity utilization increases. With world demand for oil products once again on the rise, and much old capacity being retired, capacity utilization should continue to improve for some time, particularly after the large new OPEC refineries in the Middle East are completed. At the present time, OPEC is not scheduling nearly as many projects for completion in the post-1986 period as they have for the period through 1986. Further, even with the sizeable amounts scheduled through 1986, we expect capacity utilization to increase sharply.

In summary, competition in refining should remain fierce and net profits negative over the next year and a half. However, at the same time, excluding seasonal movements, profits should improve fairly steadily, leading eventually to healthy revenues for the industry survivors.

FIGURE 6

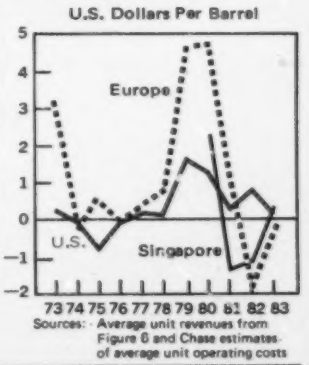
REVENUES PER BARREL OF FEEDSTOCK



Sources: Feedstock cost data from *Platt's Oilgram* and Chase yield estimates

FIGURE 7

CASH OPERATING PROFIT PER BARREL OF FEEDSTOCK



Sources: Average unit revenues from Figure 6 and Chase estimates of average unit operating costs

David J. Behling Jr., Colin P. Carter with Charles Doerr

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Please note by circling the appropriate choice.

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   b. Independent refiner
   c. Integrated company, operating primarily in one country
   d. Integrated company, operating in more than one country
   e. Petrochemical manufacturer
   f. Services (drilling, manufacturing)
   g. Other (please specify type of activity)
   _____
   _____
2. Government-owned Petroleum Company
   a. Independent producer
   b. Independent refiner
   c. Integrated company, operating primarily in one country
   d. Integrated company, operating in more than one country
   e. Petrochemical manufacturer
   f. Services (drilling, manufacturing)
   g. Other (please specify type of activity)
   _____
   _____
3. Other Energy (please specify) _____
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6. Financial Institution (please specify) _____
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7. Other Service (please specify) _____
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8. Educational Institution.
9. Government
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   b. Between $50 to $250 million
   c. Between $250 million to $1 billion
   d. Between $1 billion to $10 billion
   e. Over $10 billion
   f. Not applicable

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   d. Operations
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